anticipation

CHRISTIAN SOCIAL THOUGHT IN FUTURE PERSPECTIVE

No. 10 February, 1972

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These papers are circulated for the information of participants in the ecumenical enquiry on "The Future of Man and Society in a World of Science-Based Technology". Comments are welcome.

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Note:

We published in the last number of Anticipation a query to readers about the usefulness of this bulletin. This produced such a very enthusiastic response that we are encouraged to continue publication.

This first number in 1972 includes statements and comments on the theme, "The Future of Science and the Social Responsibility of the Scientist", as submitted to the Church and Society consultation convened at Nemi, Italy, in June 1971.

A word about the contributors:

- Prof. Charles Birch of Australia is well-known for his previous writings on the themes faith, science and the future. He is Head of the School of Biological Sciences of the University of Sydney and is Vice-Chairman of the Working Committee on Church and Society;

- Prof. Bentley Glass, former President of the American Association for the Advancement of Science, is one of America's most distinguished biologists and is presently Academic Vice-President of the State University of New York. He was born in China of Southern Baptist missionary parents; this is his first contribution to World Council studies;

- Prof. Ben Nwosu is Lecturer in Physics and Head of the Department of Physics in the University of Nigeria (Nsukka);

- Canon David Jenkins, a well-known British theologian, is Director of the Humanum Studies for the World Council of Churches.

My colleague David Gill had the good idea to tape-record an interview with Dr. Lynn White, Jr., Professor of the History of Science, University of California at Los Angeles, during his visit to Geneva in September. Prof. White is author of the now famous essay on "The Historical Roots of Our Ecologic Crisis", published in 1966 before the concern for the environment had become so widespread. Indeed his essay helped many to see the fundamental issues at stake in the ecological question. In this interview he offers us further insights on his thinking.

Paul Abrecht

SCIENCE LOOKS WITHIN ITSELF AND TURNS OUTWARD *)

by

Charles Birch

For twenty years science in the developed world has been on the crest of a wave that has surged forward with enormous speed on many fronts. Science has received increasing budgets, there has been unprecedented increase in research, some of it enormously expensive. Science courses in both universities and high schools have been radically transformed. But now the affluence of this period seems to have come to an end and a period of questioning and criticism of science is in full swing. The respect and awe in which science and scientists have been held since Sputnik I has begun to decline. Governments are disenchanted when they find that high expenditure on research and development does not automatically increase GNP. Some major technological breakthroughs have not quite come off, despite the expenditure of astronomical sums on them. Youth has begun to turn against science, particularly physics "which made the bomb". And there are older critics such as André Malraux who says that "the most basic problem of our civilization" is that it is "a civilization of machines" and that "we for the first time, have a knowledge of matter and a knowledge of the universe which ... suppresses man" (Pitzer 1971). Science and technology are blamed for pollution which is now a global phenomenon of unknown magnitude. Science has become a partner of the military in inventing some of the most horrible forms of death known to man. Even within science some proclaim the end of science. Molecular biologist Gunther Stent of the University of California sees in the rise of the antiscience hippie cult a portent of the end of science and indeed of the rest of culture. His series of lectures on this subject in Berkeley in 1967 drew a large response from students and must have had a considerable appeal to the flower people. His lectures have since been published in The Coming of the Golden Age (Stent 1969). The historian Theodore Roszak (1971) wrote what he calls "Autopsy on Science" as though science is already a corpse, "an empire", he says, "decayed from within" which "exhausts the intellectual terrain as it races forward". Some of us find if to be the opposite. Far from exhausting its field, science is forever revealing the yet undiscovered beneath the surface. Knowledge may grow arithmetically but ignorance seems to grow geometrically! The more that is known the more there is yet to be known. What Roszak criticizes in science may be a feature of the "Faustian deal" that some science makes with the so-called "military-industrial complex" but this cannot be equated with all science or even most science. Some prophets of anti-

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*) Address to the opening plenary session of the Working Committee on Church and Society of the World Council of Churches on "The Scientific Future and the Social Responsibility of the Scientist - The Current Debate". Sunday, June 20, 1971, Nemi, Italy.

science, such as Ellul and Marcuse encourage, as Sir Eric Ashby (1971) has remarked, "disaffiliation from the contemporary scientific culture on the ground that if its values are adopted, mankind will become enslaved by his technocracy. Indeed they say it is already happening." Ashby's comment on this is that they confuse the purposes for which science is done by scientists and the purpose for which science is used by society. But this is to avoid the issue raised by the prophets of antiscience. Unless scientists are concerned with the goals of science and these goals are creative and meet human needs, then the hippies are right, we would be better off without more science. I shall argue that the responsibility of the scientists is far more than "to be on tap but not on top" as Ashby claims. That is a policy that makes the scientists the means of any end, good or bad. More and more scientists with a social conscience are beginning to argue that they must have some control of the tap.

Some scientists have become quite pessimistic about man's ability to control anything about his future. The astronomer Hoyle (1964, 1965), for example, claims that the evolutionary biologists who preach the good news of "cultural evolution" are misleading the public by insisting that he is. Hoyle sees us as being swept along by the tide of events like a canoe on rapids, with no real power to direct the forces that are moving us, be they nuclear holocausts, the deterioration of the environment or uncontrolled population growth. Man will be just as subject to the forces of natural selection acting through catastrophes, he claims, as all other species. By contrast, Nobel laureate molecular biologist, Jacques Monod (1970), has recently given science almost a religious role in framing the future destiny of man. In his book, which, according to reports, swept France by storm this year, Monod argues that science has robbed society of those beliefs upon which it has up to now based its value systems. "Man knows at last that he is alone in the indifferent immensity of the universe, whence he has emerged by chance. His duty, like his fate is written nowhere ..." So he argues man must start all over again from different foundations and write his future in terms of what science tells of his origin and his nature.

There is a babel of voices inside and outside the house of science proclaiming various roles for science and the place of scientists in determining that role. The two extreme views seem to fit rather well into what Greenberg (1969) has called in his discussion of the subject of science and government in the U.S.A., the "immaculate conceptionist" and the "corruptionist" schools of thought. The former sees goodness and light in the relationship that has flourished between science and government since World War II. The latter is expressed by a quotation from Robert M. Hutchins, former president of the University of Chicago. "My view, based on long and painful observation, is that professors are somewhat worse than other people and that scientists are somewhat worse than other professors ... There have been very few scientific frauds. This is because a scientist would be a fool to commit a scientific fraud when he can commit frauds every day on his wife, his associates, the president of the university, and the grocer ... A scientist has a limited education. He labours on the topic of his dissertations, wins the Nobel Prize by the time he is 35, and suddenly has nothing to do ... he has no alternative but to spend the rest of his life making a nuisance of himself."

The Good News of Damnation

It is no wonder then that science is now looking within itself. The tumult of our times has shattered the ivory tower of detachment in which so many scientists have spent their happy hours. The traditional stance of scientists has been a detachment from the use of the results of their research. Decisions about the use of science have been left to politicians and industrialists. But now we find an increasing number of scientists, engineers and social scientists discussing ways of forecasting and controlling the long range effects of innovation. If you ask them why they are now spending their time doing this, they give a variety of answers. These are some I have heard recently. The scientist is at the fountain head of the new knowledge and that in itself makes him responsible. He knows more about the facts of science than the politicians and industrialists who use it and therefore has a special responsibility. He finds his own work being used to ends he deplores. The ivory tower attitude has failed to bring the benefits of science to the community, instead he sees it being used to satisfay greed of a few. The gap between discovery and application has become so narrow that it is difficult for the scientist to evade the social and political implications of his discoveries. He seems to have become, willy nilly, the sorcerer's apprentice and for the first time sees the possibility that science and technology could become the instruments that could annihilate the human race. And so on.

And what is frightening is the notorious difficulty of predicting the consequences and the side effects of new discoveries in science. Louis Fieser of Harvard University who compounded Napalm for the first time during World War II, had, he said "no thought of the use of Napalm against non-military personnel". The German chemist who, a century earlier, compounded the substance polystyrene had no knowledge of Napalm nor of the use that was to be made in recent years of this substance in a superior napalm enabling it to stick more effectively to its victim. Paul Müller in inventing DDT did not know that its persistant properties would result in it reaching every corner of the globe and accumulating to lethal levels in some non-target organisms. Gerhard Schrader in the course of developing a more potent insecticide chanced upon a formula for an organo-phosphorus compound with a profound paralyzing effect on nerve transmission in mammals; his discovery later provided the Nazis with the agent Zyklon B, the so-called "nerve gas" for murdering the occupants of Auschwitz in their "shower rooms". The story of the atom bomb began not with a group of scientists getting together to make a bomb but with Eddington's great conjecture about the inner constitution of the sun. The energy there was greater than any known source on earth but what was it? From that conjecture the hunt began.

From these and similar events in the history of science I can only draw the conclusion put so well by Visser 't Hooft (1971) that "... at a time when scientists can change the course of world history it is no longer possible to deny that they bear a tremendous responsibility. But if this is so, we must not leave them alone ..." And that is why some of us are at this meeting. We believe that the scientist has the responsibility of any educated person; to make himself responsive to the human situation, especially in areas where he has special knowledge. An increasing number of scientists

are pulling themselves out of the test tube to look at the world around them and are experiencing an awakening of conscience as a result of seeing more clearly the threats of the future. This is the good news of damnation. In my own area, population ecology and evolution, I think now of three leading workers on the West Coast of North America: Paul Ehrlich, Kenneth Watt and W.H. Holling. Each has been labelled an ecological Jeremiah, each having become aware of the gravity of the ecological scene and having radica changed his research programme to ones centred on man and each now spends a great deal of time arousing a public to awareness of the issues they see so clearly. How any particular scientist will respond depends upon many things "What is our responsibility?" asks Serge Lang, Professor of Mathematics at Columbia University, "I don't know. Probably there is no answer, valid for all of us, for all times. It depends on how bad the situation is at any given moment. It depends on how much hope you can have for curing the evils of the situation. It depends on how bright you are. It depends on how many graduate students you have. It depends on how old you are, how many childre you have, how big a family you have to support. It depends on how repressiv the established forces are." (Brown, 1971).

That human statement expresses for me the depth of the personal decisions that some scientists are facing at this time and it points to a role for others who are responsive so that they are not as Visser 't Hooft pleads, left alone.

A Transformation of Consciousness

We are now on the verge of a transformation of consciousness in the scientific community that is expressing itself in a mushroom growth of new societies and new teaching programmes which have as their concern the social responsibility of the scientist. The total number of scientists who are so involved must be a tiny proportion of all the scientists in the world, most of whom pass by on the other side. Nevertheless, a saving remnant may alter the course of history now as it has in other areas in the past.

> "If I find in Sodom fifty righteous within the city
> then I will spare all the place for their sakes."

As the story goes, after a consultation with Abraham, God reduced the figure to ten "If there are ten righteous, I shall not destroy the City." The parable is appropriate now. Existence on this planet is sustained by a perilously slight margin of sensitivity. The creative advance of any generation rests upon the responsiveness of a pitiable small margin of human consciousness. But it is the leaven that can influence the whole loaf.

On a world scale this movement is hardly yet united though there has existed for about 20 years the World Federation of Scientific Workers (WFSW). This has, in recent years particularly, been active in the peace movement and in other specific issues of social concern. For example, the WFSW is holding a symposium in Holland in July 1971 on "Problems of Young Scientists" which is to be a forerunner of a larger meeting on "The Scientists in Society" to be held in Moscow in 1972. In Europe "Survival" is a group endowed with leading mathematicians who produce a publication of the same name concerned

with radical political and social commitments. In Italy a group called "Potere Operaio" has organized strikes of research workers. Its philosophy is that the scientist is a worker and as such should deny the state his labour when it is used for maintaining a situation judged to be evil. In the U.S.A., Scientists and Engineers for Social and Political Action (SESPA) has offered its intellectual resources to congressmen who seek an alternative to the official scientific advice from the Pentagon. SESPA was instrumental in making the ABM an issue at the April 1969 meeting of the American Physical Society in Washington. SESPA members sent each Congressman a brief discussion of the problem of the ABM along with an offer to provide him with a personal scientific adviser so that he could keep up with the many problems in technology on which he has to make decisions.

The Scientists Institute for Public Information (SIPI) exists to better inform the public on scientific matters of social and political consequence. Its publications include the highly informative and influential journal Environment. SIPI played a major role in the partial test-ban treaty. The so-called "research strike" at M.I.T., March 4, 1969, was a consequence of an idea dreamed up by two graduate students of physics who were groaning over the unhappy state of the world and the role of science. From M.I.T. there arose two groups, the Union of Concerned Scientists (UCS) mostly staff, and The Science Action Coordinating Committee (SACC), mostly students. Both now have chapters around the country. UCS has initiated scholarly studies on issues of science of public concern such as ABM and MIRV weapons systems. SACC has been instrumental in bringing some changes in MIT's relations to this war work. The "Scientist's Committee on Chemical and Biological Warfare" was set up at the 1968 meeting of the American Association for the Advancement of Science to obtain information on CBW and to educate the public with their findings. These are just some of the organizations of scientists which have sprung up over the U.S.A. In the United Kingdom, Canada and Australia groups for Social Responsibility of Science have become centres of concern over the past few years. Their membership is open to anyone, scientist or otherwise, who is concerned about the use of science in the modern world.

The University of California at Berkeley has led the way with credit courses on Social Responsibility of Scientists. This Spring the subject "Biochemistry 150" was, in reality, "Biochemistry and Society". The announcement of the course read: "This course will attempt to put into perspective the effects of biochemical research and technology on society. It will do so with a selection of examples which will be presented in five sections: history, sociology and politics of biochemistry; air pollution; mutagenesis; agricultural chemicals; chemical-biological warfare ... The course will offer a biochemical perspective on the technological intrusions which threaten life and will analyze the professional responsibility of the biochemist to society." The first of this type of course was given at Berkeley in 1969, following the formation of a group called Science Students for Social Responsibility (SSRS) who saw the need for a strong technical and factual content to discussions on social responsibility of scientists. Professor Joe Neilands (Biochemistry) and Professor Charles Schwartz (Physics) sponsored the course which was given by an impressive array of scholars. Their lectures have since been published in the book The Social Responsibility of the Scientist, edited by Martin Brown (1971). "The impact of science on society" is another course at Berkeley within the science group. Nor have

other departments of the University been inactive on this front. Political science has a course entitled "Technology and Politics" and another "Science, Technology and Future World Politics", and Engineering lists "Technology and Science". So far as I have been able to discover, theologians have not participated in these courses. I suspect the scientists do not consider their interests to be relevant and the theologians tend to feel that they can make little contribution without being expert in science. Both attitudes, I believe, are wrong.

A meeting of theologians and scientists has been engineered in at least two important new groups in the U.S.A. One is the U.S.A. Task Force, "The Future of Mankind and the Role of the Christian Churches in a World of Science Based Technology" directed by Dr. J.E. Carothers in New York.

A more specialized group is the recently formed Institute of Society, Ethics and the Life Sciences at Hastings-on-Hudson, New York. It has a director and staff and an advisory board consisting of theologians, social scientists and biologists. They are initiating a series of studies on ethical problems arising from biological discussions. For example, the cells of the unborn can now be examined by amniocentesis (withdrawal of amniotic fluid surrounding the foetus) and identified for specific genetical diseases. About 70 genetic disorders, most of them serious, can now be identified in this way. The question thus arises, should foetuses identified as genetically defective (e.g. mongolism) be aborted? How serious should the defect be to warrant abortion of the foetus? To what extent should all foetuses be screened in this way? How is the cost of genetical screening to be balanced against the cost of other medical services if there is not enough money to do everything desirable?

"Science for the People"

The modern world is shaped by science. But it is also true that much of science is shaped by the requirements and constraints put upon it by society. It is fallacious to suppose that science is some sort of external agent acting on society. Science is itself an aspect of knowledge that can be socially determined. The sort of science that is done is neither as inevitable nor as unpredictable as is often supposed. What can be done does not necessarily have to be done. In this respect the vote of the U.S. Congress against the SST is the major example of a technological possibility that has been shelved for political or social reasons. Let us hope that the real reasons had to do with social priorities. In their book, Science and Society, Stephen and Hilary Rose (1969) conclude that society gets the science it neither demands, nor deserves, nor needs, but some uneasy compromise between the three. It is neither avoidable nor wrong, that constraints exist. "The questions we have to ask in the long run, must take cognisance of them. They are: what sort of science do we want? how much of it do we want? who should do it? how should they and their activities be controlled? But the fundamental question underlying all these is: what sort of society do we want?" That is a question that has to do with priorities in human values and in which a scientist may be no more qualified to speak than anyone else. What is desperately needed is that he does speak

with others and that these others speak with him. When did the community decide that it wanted to invest money and skill on the development of heart transplants? or supersonic aircraft? or CBW? or persistent insecticides? Some are arguing that these sorts of problems are highly technical and only the experts can make valid decisions. The "elitist" solution is not a solution. Scientists in places of power are no less prone than others to the evils of bureaucracy, even those who in their youth have altruistic aspirations. A colleague of mine tells me that a critical problem that faced the Chinese during their Cultural Revolution was how to prevent idealist and revolutionary science students from aging into conservative and self-centred bureaucrats. One of them put it this way: "How can we serve the people during our whole lifetime and eliminate the old selfish attitude characteristic of the professions?" If science is to better serve society we need to make a much deeper study of what Ashby calls "the study of the use of science in decision making" (Chedd, 1971).

The special responsibility that falls upon the scientist is twofold. He has a responsibility to interpret current science to society and he has a responsibility to assess its consequences and influence its use. These are roles that he can perform in a way that others cannot because of his special knowledge. Societies for social responsibility of scientists have an inward turning function to rouse the sense of responsibility of scientists and an outward turning function of educating public opinion about science.

The scientist who takes seriously his responsibility as a scientist in the ways I have been discussing will find himself asking what sort of science and what sort of technology has highest priority in the world now?

There may have conceivably been a time when a scientist could responsibly retreat into his laboratory and pursue his insatiable curiosity about barnacles or quarks to his heart's content without a concern about whether one sort of knowledge is more worth pursuing than another. If there were any such a time, that time is no longer. There are some questions in science that are more worth asking than others. The alternative view is that whatever science can know science should know. But what science could know is infinite. The horizon of possible search expands rather than contracts with time. Choices have to be made. It is not good enough to repeat the old clichés that science operates best by freewheeling in "basic research" without reference to the needs of the world, that no one can predict what will pay off in research, that only one in a thousand shots in science pays off and that one is unpredictable, so how can we determine a direction for science. Hence the jibe of a former U.S. Secretary of Defense that "basic research is when you don't know what you are doing". A lot that is trivial hides under this umbrella; the research that Sir Eric Ashby called "crowding along the frontiers of knowledge with a hand lens". Furthermore, the argument is not at all well established that the technological advances of our time have mostly sprung from fundamental undirected research. Undoubtedly some has. Just as undoubtedly many technological advances just do not conform to that picture. "It would be convenient", writes Greenberg (1969), "if a comprehension of thermodynamics had paved the way to the creation of the steam engine, but, if anything, it appears that the steam engine paved the way to a comprehension of thermodynamics - and the inspiration for this effort at comprehension was a desire for a still more efficient steam engine".

It is sensible then to look for some criterion in choosing what sort of science. The one I shall propose is: "Science for the People". Science for the people means putting a high priority on those questions that need answering if man is to survive our planetary crisis or what John Platt (1969) has called our "crisis of transformation". "The human race today", he says, "is like a rocket on a launching pad. We have been building up to this moment of take-off for a long time, and if we can get safely through the take-off period, we may fly on a new and exciting course for a long time to come. But at this moment, as the powerful new engines are fired, their thrust and roar shakes and stresses every part of the ship and may cause the whole thing to blow up before we can steer it on its way. Our problem today is to harness and direct these tremendous new forces through this dangerous transition period to the new world instead of to destruction. But unless we can do this, the rapidly increasing strains and crises of the next decade may kill us all." In determining priorities for research and development Platt urges the formation of special task forces of scientists and others for research and development. This would be a focussing of brains on social issues. A conclusion some of my colleagues are coming to is that science for the people may mean we should have as a goal de-development in the developed countries and partial development in the developing countries. (See Ehrlich and Ehrlich, 1970). A group of international scientists called "Intermediate Technology" argue that what is needed in the developing world are techniques that use only native labour, resources, traditional customs, and teachable know-how so that people can further develop in their own style. This avoids cultural imperialism. Such intermediate techniques may pose extremely subtle problems requiring careful research and great human understanding. This move to make technology more humanistic comes from within science. It is a point of view which is supported by a statement made by the late Thomas J. Mboya (1969), "... it is unnecessary for men to be brutalized by science and technology and this can be avoided with appropriate investment and some ingenuity. I simply do not agree with those who maintain that the entire burden of development must be borne by people who must radically and suddenbly change their tastes, abandon their tradition and institutions and alter their attitudes and values." The U.S.A. is setting a pattern of urbanization and industrialization that other parts of the world are trying to follow. That this is not sustainable is a conclusion of systems studies of world dynamics such, for example, as those being made by Forrester (1971) at M.I.T.

Destiny came down to an island, summoned three men and said: "What would you do if I told you that this island will be inundated by a tidal wave tomorrow?"

One said: "I would at once eat and drink and make love and do all the things I missed out on."

The second said: "I would take my loved ones to a sacred grove and make sacrifices and pray that we be prepared to enter paradise."

The third said: "I would assemble our wisest men and begin to study how to live under water." He was a scientist and his science was science for the people.

If there are to be social benefits of science in the future they are not going to be largely fortuitous. They will be the result of socially determined goals pursued with a purpose. Such purposes as national prestige or the building of technological monuments to big science which bring little benefit to mankind will then be seen for what they are, activities diverting us from our real purpose which is the enrichment of human life.

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THE FUTURE OF SCIENCE - ENDLESS HORIZONS OR THE GOLDEN AGE?

by

Bentley Glass

I begin by sharing with you a few of the thoughts which I put in an address that was published later in Science and which had the title "Science Endless Horizons or Golden Age". The reference to "endless horizons" is to a very common view of the scientist of past decades, that scientific inquiry is the essential frontier, challenging the mind and bearing of man at the present time and in the future. There is, in this view, essentially no end to the possibilities of the discovery of knowledge and its applications for the welfare of man.

The phrase "golden age" comes from the title of a book written by my fellow molecular biologist Prof. Gunther Stent of the University of Californ at Berkeley. His book was entitled The Coming of the Golden Age: A View of the End of Progress. His thesis is that the main tasks of science are alrea complete and that there is very little to do from now on except to fill in some modest gap. I think he is altogether too restricted in his point of view to molecular biology itself of which this might with possible justice be said. Certainly if you look at a field like neuro-sciences, one would have to admit that the scientists have barely scratched the surface and that what we have to learn about the structure of the human nervous system, the brain and the organization of the mind is scarcely more than a dim visio at the present time.

These are the two opposite ends of the spectrum of opinion about the possible future of science as a human enterprise. My own view I place somewhere between these two but considerably closer in actuality to Gunther Stent's view than to the view of Endless Horizons. I do that on the basis of two considerations which I think are cogent: (1) the finiteness of the universe and (2) the uniformity of natural law throughout that universe so far as we can determine it. Thus there would seem to be inherent limitation to ultimate knowledge. Just so many laws of motion, just so many laws of molecular biology, just so many understandings to be gained about each and every area to which the mind of the scientist and his experimental methods might be applied and then there will indeed be nothing left but filling in some of the gaps and making perhaps an almost indefinite number of applicati I would offer you a few examples to show that a science can indeed be essentially completed and that it then no longer attracts new scientists into it; and it remains as a body of useful knowledge, or perhaps useless knowledge but without being essentially expanding.

A good example I think is human anatomy which first filled up insofar as the anatomy of the body is concerned several hundred years ago. And then as far as microscopic anatomy is concerned was largely completed in

the 19th century over into the early part of this century and with the development of the electronic microscope, the extension of the knowledge of human structure down to the very atoms and molecules of all the cells is rapidly being completed. It is not complete yet at this newest level but I suspect that at the rate at which new knowledge is being developed at the level of electronic micrography that will fill up and fill out far more rapidly than did the physicology and psychology of the previous period of human anatomy.

Or take zoology as another example (I speak of those particular sciences with which I am most familiar). It seems that there are on the earth only about a million and a half species of animals, and surely when we have exhausted all there is to be learnt about these million and a half species of animals, some of which may indeed become extinct before we get around to it, that will be all. We are not going to make any new species very quickly and we are not - I would say at the present time - even at the point of knowing all the interesting and useful things that can be learnt from even one species, such as my own pet the fruit-fly, about which more is probably known than any other organism, and the homo sapiens. But with a sufficient amount of application one can say that there is indeed an onset of diminishing returns and that there is not likely to be anything new in principle to be discovered beyond a certain point.

The other factor which would lead me to conclude that there are some finite limits to the amount of possible scientific knowledge about the universe, is the exponential rate of scientific growth during our own century, and particularly during the past 50 years. We know of no example of exponential growth that can continue very long, that sooner or later does not meet with some kind of limiting factors which will bring it to a halt. There is no doubt, I think, about the fact that in the western world the growth of the scientific activity has been proceeding exponentially during this century. And the consequence of that is the fact that the material condition of human life in 1970 is probably more different from that which existed in 1920, than the material conditions of human life in 1920 were different from those at the beginning of the Christian era. This is the kind of explosive change in the nature of human life that we owe to various applications of technology. I could point out to you for example that the increase in the human life-span, in the life expectancy in Western Europe and North America, has increased more in the past 50 years than in the previous 100 years before that. But I do not expect that the next 25 years will see an equal extension of the human life-span. We are running into some sort of a ceiling and there will have to be a real and unexpected breakthrough if that is to happen.

The numbers of scientists, scientists plus technologists, a strange category that seems to include laboratory technicians but not university professors of science, is documented in the United States census records and here you can readily determine that the number of scientists and technologists in the United States has been doubling approximately every 12 years since 1930, perhaps before that, I have not actually looked up the earlier census records. This means a little more than a 5% per annum rate of increase in the numbers of persons engaged in this kind of professional activity. The population itself has been increasing at a very much lower rate than that and we are worried about the explosion of the scientific community which is growing faster than any population in the world, or has been up until now. At any rate, it cannot surely go beyond the point where every man, woman and child is a scientist or technologist; and it will very soon reach that point if it continues to expand at 5% p.a. I therefore submit that there must be some kind of a slow-down in the rate of scientific growth insofar as mere numbers of persons engaged in the enterprise throughout the world are concerned. This may be offset for some time of course by relatively rapid increase in the numbers of scientists and technologists in countries which do not yet have a very large establishment of this kind, but by and large I think we have to consider that the brakes are beginning to be applied.

The number of original scientific papers published annually has been increasing at a rate of more than 5% p.a., doubling approximately every 14 years, since about the year 1820. Not only the number of original papers has been doubling at that rate but the number of journals in which they are published has been doubling at that rate, and even the number of abstract journals which attempt to summarize all these papers has been doubling at every 10 to 14 years during that period. Here again I do not think that this time of great increase can possibly continue very long into the future. We are drowning in paper; we have more information than we can read, than we can absorb, than we can index, than we can code, than we can put into computers and retrieve. Even if we had a good system which we do not, for the coding of existing scientific information, I would estimate that about 90% of all the scientific information now being discovered, is almost immediately forgotten and ignored and that the scientist of the future will not need to go into nature to rediscover things, but will only need to exhume findings from the literature.

In other words, my conclusion is that although we are far from completing the task of natural science at the present time, and although there are still virtually virgin areas like the neuro-sciences to be explored, we are so rapidly approaching, at this exponential rate of increase, the limit of scientific knowledge that I would expect that within a century or two scientists, still interested in working in these fields, will be concerned

mainly with applications of knowledge or with a filling in of the minor gaps which will still remain. Of course, I am not speaking here of such sciences as anthropology and sociology which are in a relatively juvenile state of development compared perhaps to the physical sciences or even to biology; and because of the complexity of their subjects may take a great deal longer to organize and explore. I am speaking here mainly of the physical and the biological sciences.

What are likely to be the limiting factors that will slow us down in the further development of scientific knowledge? I have mentioned already the ratio of scientists to the total labour force. I estimate myself that we can hardly expect to go above a ratio of about one fourth of the total professional labour force, and what proportion the professional labour force is of the total labour force certainly differs in different countries so much that it is hardly necessary to emphasize that. Another and very important factor is the rapidly increasing expense of scientific work. When I was a graduate student and just getting my doctoral degree I would have been very happy indeed if someone had presented me with a $200 binocular microscope and given me several 100 dollars a year for the food and the glassware that I needed for my fruit-flies. By the time I ceased my laboratory work when I went to be a university administrator, I was finding that 25,000 dollars a year for my scientific work was quite sufficient and I had access to and used frequently expensive types of equipment that I did not have to pay for out of my own research money. Today the molecular biologist, the physicist, the chemist requires an enormous amount of capital equipment in order to be able to carry on his work. And that tends to apply a brake to the growth of science.

My conclusion then is that the number of scientists in the world and the technologists who form another part of this professional group, must soon come to an equilibrium and maintain a steady state which will be determined by the growth of population itself and by the growth of the basis of support and the gross national product of each country. If the population reaches zero growth and the economies of countries come into a steady state, then I suspect that this exponential increase in the scientific activity will diminish also to some kind of a steady state which will be perhaps much less expensive and involve even fewer people than now.

The Developing Social Conscience of the Scientist

And now let me pass on to the second part of my remarks, the topic of which might be, "The Sale of the Scientist's Soul". Up until the period before World War II, you could still with some justice speak of the scientist in his ivory tower remote from the concerns of society, pursuing

scientific proof where his interest led him and where his techniques permitted, and very little interested, in fact warned by his elders not to meddle, in Government and politics or to concern himself with social matters But the increasing expense of the scientific enterprise has led to a need, of course, for increasing financial support and that is marked by the very great growth, from the period of World War II on of grants and contracts from government agencies, support from industry and a certain amount of support from charitable foundations, although at least in the United States that has been diminishing except in special areas. My own support when I was a graduate student and a post-doctorate came from the Rockefeller Foundation for quite a number of years but the Rockefeller Foundation has long since given up that kind of support of scientific programmes and has concerned itself only with the development of the food problems of the tropical countries in more recent times.

Scientists and engineers have increasingly during these past 30 years been recruited into state agencies such as the Atomic Energy Commission in various countries or into government-funded military aid establishments in industry. And in the United States we are now experiencing a great deal of technological unemployment among scientists and engineers because of an abrupt cut-back in this kind of support, in both the state agencies and in the government-funded military industries.

My conclusion which I have written out here, I would like to read: The scientist today has accepted from society the support needed for his work and the price he pays is the social direction of his work. He is a servant or a slave of the social order in which he lives. Because of the ends to which his work has been applied he has known sin. Never again will he be able to follow the truth wherever he chooses or wherever it seems to lead. There may of course be rare exceptions but I think this will be the general rule. He now per force thinks deeply of the applications of science and technology to the quality of human life and he questions as never before both his own aims and the goals of his society. He has begun to discover his soul.

Is There a Future for Science in Africa?

by

Ben Nwosu

The problem posed is one which we scientists from the developing countries are, by training and experience, not truly qualified to take up if compared to our scientific colleagues in the highly developed countries. And while I am pleased to speak on the same platform with Prof. Birch and Prof. Glass, I do not claim their eminence and experience.

However, if we shift the frame of reference to the African scene and possibly to the other developing countries, maybe then with some humility I and my colleagues can claim to be scientists. And in that role I speak to this topic.

What is the scientific future in the Third World, in Africa, in Asia, in Latin America? What is the future of scientists in these various places and what is their responsibility? How can the scientists of the Third World relate to their colleagues elsewhere and to the situation in the rest of the world?

Prof. Birch mentioned some of the points in the latter part of his address which get us all worked up, which get us all very emotional. Because scientists in the Third World see no future at all for themselves. I am not a prophet of despair but I believe I represent their feeling. In other words, our main response is complete frustration and we see a very bleak future indeed.

Before coming here I was engaged in some discussions with many of my colleagues on this very question. And I discussed with them on a very informal basis the question of the future of man and society after our conference last year. At our discussion I said to them: "Gentlemen, as I see it in the year 2,000 A.D. the greatest thing that will happen to science and technology in Nigeria is that we will have an automobile assembly line in Lagos (the capital of Nigeria)." You may not get the joke. You in the industrial countries manufactured cars in 1900; in 1960 we learned to assemble them. That is the future of science and technology in our countries! A long time after you have built airplanes we may learn how to assemble them; and thirty years after you have gone to the moon we may learn how to assemble the spaceship which you have constructed 30 or 40 years ago.

For us scientists in Africa who have had most of our education in the Western world and in the highly developed societies, this situation is extremely frustrating. By our training and education we can understand the issues which are raised by emminent scientists such as Prof. Birch and Prof. Glass. We can follow their logic; but the problems they pose seem totally irrelevant to the situation facing us. Here we all are on the spaceship earth; and you are worrying about exponential growth and looking to the end of molecular biology, etc. while we are only beginning to discover what can be achieved through science.

There are several reasons for this bleak prospect and emptiness. First, the problem arises from the type of political and national leadership existing in the developing countries. They often fail to acknowledge the young African physicist or young engineer in their midst, trained in MIT or Oxford or Cambridge, with first class honours. Instead they will often look for or accept a very inferior person from a developed country. The reason is that it gives them satisfaction and pride if the scientific advice comes from the people who were formerly their colonial masters. It would not be the same if such advice came from their own countrymen.

In other words, science as I have known it in the Western world does not really exist in our countries yet. (I thought this was true only in Africa but last year when I discussed this point with a few of the scientists from South America, who are more advanced than we are, and also with those from the Middle East, I was quite surprised to find that they have the same frustration and the same feeling as I express.)

I suspect too that there is an overt or covert unwillingness on the part of our own colleagues, I mean our fellow scientists and technologists in the West, to initiate us into their circles. (I refer to what is known to us in Africa as initiation rights! No matter how old you are, no matter how experienced you are - unless you have been initiated you are not accepted. Unless you go through the proper channels you don't know anything.) As a result, and it is part of the problem, we are dealing with what I call book knowledge science. What we call Third World scientists are often just mere crammers and reproducers of what others have done.

Another reason for this bleak future or this disturbing state of affair is our own leaders' desire to get us all to support them. Science and technological work is too often sacrificed to purely political consideratio

Related to this is the terrible sense of materialism which has gripped our own scientists and technologists. This statement may seem to be in contradiction with what I said above about not getting encouragement from the national leadership, but it isn't. You find that Ph.D. scientists

get appointments to a board or government corporation which will bring an extra 1,000 or 2,000 £ a year. He gets appointed to the new steel authority which the Russians or Americans are going to develop. He doesn't know anything about the industry, but he is on the board of directors as a steel consultant of the new £ 200 million plant, so that is another extra £ 1,000. When you add this up and convert it into dollars he might be earning more than his own colleagues in the United States. This is a new trend, where the few of us who have had a good education and who are not given the opportunity to do real science and to aid our own people, are nevertheless elevated. And of course we are invited to attend international conferences! If you go to Lagos and see some of the houses of some professors and their furnishings, I am sure that some of you Westerners would be quite jealous.

I am not providing any solutions, but these are some problems which in my view, determine our scientific future and the ability of the African or the Asian to feel that he is really a part of the scientific community.

I would like next to take up the question of the scientist's social responsibility. This is where there is some common agreement between my own views and those expressed earlier by some of my distinguished colleagues.

The pressures which we Third World scientists are subjected to, to do certain things is increasing. Even though I am a young scientist I am not a young man. At the time we started scientific work (we had very good British tutors and lecturers in the middle 40's) we loved this question of pursuing the truth for its own sake; of getting results and of speaking the truth. But then I found out that even in the primitive state of our own science you are influenced by government, by how much money is available, by what results the government in power, or even the public too, want you to get. The next pressure that is coming was predicted by a professor in Geneva last year. I have forgotten his name but I was very much impressed with his paper. He mentioned something about discoveries in the biological science and warfare and hinted that since it was so easy to manufacture these biological things, maybe the Third World in order to match the nuclear blackmail might as well take up some of these things and have something to use as pressure on the big powers!

It is this type of pressure to which my scientific colleagues from the West are referring. They have their own pressures at a very high and advanced level; at our own level there is another pressure coming from our frustration. When you talk about the moon landings out of jealousy and perhaps out of spite, we say we don't want to hear about it; you tell us about ecology we say we don't want to hear about ecology; you tell us about population control and we don't care about population control. I agree

that this attitude is irresponsible. But the important thing is for the scientists and the technologists and also the leaders of opinion who are gathered here to appreciate that this feeling, this lack of cooperation, arises from the fact that we feel so cut off and so low, and that you are not trying to elevate us to your level. So we are not interested in what we think are your problems, but which every right-thinking person would agree are the problems of us all.

I have said that we must discuss the future as we in the Third World see it. We need more opportunities for this. We must discuss our responsibilities and I agree that scientists have to organize and mobilize opinion on the critical issues facing our peoples. I hope we'll have more opportunity to discuss this at a regional meeting in Africa. The only appeal I make is that, as the scientists and technologists of the Third World, are willing to cooperate with our colleagues in the scientifically advanced countries in this soul-searching effort, our scientific colleagues in these lands might help us to become scientists in the full sense of the word.

Problems of Biology and the Quality of Life

Proposals for Basic Working Principles

by

David Jenkins

In an interdisciplinary inquiry it is particularly important to be clear and explicit about a starting-point because it cannot be assumed that there is a shared tradition about the nature of the realities under investigation and the proper methods for investigating them. It is, for example, not *prima facie* very clear what, if anything, biologists, theologians, moral philosophers and social scientists have in common in their respective customary methods of investigation for dealing with problems.

It seems desirable therefore to propose some working principles for agreement or for such modifications as will lead to agreement. These working principles should, presumably, be seen to arise from and, be relevant to the general area under investigation. It is suggested that our area of investigation may be understood as follows.

References to "the crisis of values evoked in our world by scientific discoveries and their applications", together with accompanying expressions of varying degrees of anxiety, anticipation and excitement, are now commonplace. When such phenomena become commonplace it is indicative of a disturbance in our customary ways of approaching and dealing with life which is worthy of investigation.

The underlying assumptions and taken-for-granted beliefs which we had about our routines and sub-routines for living our lives, handling our professional, family and personal questions, and so on, have somehow ceased to work smoothly. There is some sort of mismatch between the way we have become accustomed to settle questions, or, indeed, to ignore some questions, and what the circumstances of our lives now seem to require of us. We experience, therefore, a series of *problems* with a new quality of unease and uncertainty.

It does not automatically follow, however, that the phenomena which are symptomatic of the disturbance are also adequately descriptive of the nature and causes of that disturbance. Thus talk of a "crisis in values" should not immediately lead all concerned persons to a direct attempt to face the value question by attempts at various combinations of refurbishing old values, realigning current values and discerning new values. For the need for these attempts arises from a disturbance to our values and to our habits of valuing. Unless we investigate, and make a sensitive response to, the nature and effects of this disturbance we shall be attempting to deal with symptoms of the disturbance by methods which have already been rendered inadequate by the disturbance itself. Such an approach is clearly self-

defeating and constitutes one more symptom of the disturbance rather than a positive response to it.

Thus, our particular starting-point may be what the working group on "Human Implications of Discoveries in the Biological Sciences" said in its report to the Exploratory Conference on Technology and the Future of Man and Society (Geneva, July 1970) viz: "The knowledge of biology not only raises in a new light the question of what is man but also the question: What is man for?" This sentence may be taken as sufficiently indicating a symptom of a disturbance which urgently requires investigation. The investigation, however, must not start with the questions actually framed in the symptomatic sentence. For these questions, as everyone knows, are, if not as old as the hills, at least nearly as old as man. The questions for investigation are what has generated these questions in the particular ways they are posed at this particular time? i.e. can we analyze the sources of the disturbance which throws these questions into a new prominence with a particular sense of urgency? In order to proceed with this type of analysis attention must be paid in sufficient detail to the actual facts of developments in the biological sciences.

It is therefore proposed that the starting-point for our investigation should be the prima facie problem-generating developments in some field or fields of the biological sciences.

Convergent reasons for supporting this proposal are, firstly, that there are strong grounds for holding that scientific activity itself is generated in its beginnings by starting from an observed and apprehended problem. Something or other somehow or other disturbs the received way of looking at things and is, thereby, a problem. It is the investigation of this problem which leads on to discovery and newness. Secondly, there are equally strong grounds for holding that the biblical story of the revelation of God is dominated by God the Disturber. It is in the unexpected, the problematic and the overthrowing that the living God and His Word are to be experienced and through which His revelation grows. Thus to concentrate on that which disturbs, that which creates problems, is to find a focus on which scientific method and theological understanding can converge.

Thirdly, that the developments are there to be observed and investigated and that they are somehow problem-producing provides common ground for various disciplines and for the practitioners of various disciplines. This ground is common independently of whether the disciplines share common approaches or methods and of whether the practitioners share common faiths or presuppositions. Thus there is a starting-point which exercises some common pressure on the interdisciplinary inquiry which it is felt necessary to undertake, a common pressure which if carefully and rigorously investigated may enable a collaborative inquiry to proceed beyond the usual generalities and expressions of concern about crisis, the need for new values and a re-interpretation of the meaning of life.

There is one further important reason for, and advantage to, starting from the developments and studying them as generative of problems. This is that the feed-back effect in such an investigation should be available to all the disciplines involved without exception. The prima facie nature of

the overall problem is that our hitherto habitual ways of settling questions to do with action, purpose and meaning are being called in question (disturbed) by developments in a wide range of scientific and technological fields and that we are proposing to investigate this phenomenon within the range of the biological sciences. The proposed method is that we should examine the particular developments which appear to be the most direct stimulators of the overall problem and work, so to speak, "outwards" from these, i.e. go from the developments through the problem-generating effects to the problems. This method should enable us to help one another (by an interdisciplinary collaboration of which the fundamental basis of cooperation is that we are all troubled human beings who agree, at least, that the overall problem exists in some form) to face and investigate the nature and implications of the disturbances in our own particular disciplines and to try and find ways in which our disciplines should and could contribute to a positive human facing up to the disturbances and challenges of the overall situation.

This way of "working outwards", together with its likely feed-back into the presuppositions, methods and aims of the disciplines involved should counteract any tendency to assume without investigation that there is some basic position in one or more of the disciplines involved that is sacrosanct from, and untouched by, the disturbances which constitute the overall problem to be investigated. Many discussions of various aspects of "Developments in Science and Technology and the Moral Crisis for Humanity", or however we may wish to characterize it, seem to assume that there is or ought to be, say, some theory or scientific objectivity or some understanding of biblical revelation or some way of accepting moral axioms which must be taken for granted before the problem can be faced, investigated and, perhaps, resolved. I am arguing that the initial hypothesis on which the investigation must initially be based is that the crisis <u>is</u> the disturbance on the hitherto taken-for-granted concepts of the nature and operation of scientific objectivity, religious revelation, moral judgement and the like. Hence to attempt to start an investigation from anywhere else than from an exemplary <u>prima facie</u> problem-generating area would be unscientific, irrelevant and imprudent. For to attempt to start from a hitherto taken-for-granted base in scientific method, biblical theology or moral philosophy would be to begin by ignoring the most problematic feature of the problem.

Consequently, the second basic working principle proposed is that <u>it is agreed that the relevance of habitual moral, theological or scientific categories has to be re-established or modified in the course of our investigations and not simply assumed as a basis or simply re-assessed</u>.

Since the starting-point of our investigations is problems and since a general effect of those particular problems is to make our whole approach to both the quality of life and the possible management or direction of life problematic, it would seem essential that the inquiry be focussed on problem-solving in order that we do not become diffused in the vast network of theoretical questions at a variety of levels which could easily arise. Hence the third principle proposed is that <u>we keep in the forefront the question "What has to be done?"</u>.

In order to proceed with the type of investigation visualized in these suggestions it will be necessary to choose some very specific field or fields

for a pilot investigation or investigations. In this connection the field of genetics is put forward for consideration. It might well be argued that broader problems like population or ecology and environment are far more urgent and should be given priority. The problem, however, of knowing how to understand the problems and then stimulate action in these fields is quite as acute as anywhere else and the very vastness and urgency of the fields as a whole tend to create more general noise than specific and realistic information with regard to answering the question "What is to be done?". Hence a pilot investigation, if carried out as speedily as possible, in a more restricted field might be a much more feasible way of developing methods for bringing interdisciplinary resources to bear on these wider fields.

The proper procedure for developing investigation, if the above approach is generally accepted, would be to establish an agreed list of problem-generating developments and an agreed description of these developments. It would probably be the case that in the process of establishing this agreed description the beginnings would also emerge of an account of how and why these developments generated broader problems. It would then be necessary to investigate this problem-generating effect further and to see if agreement could be reached of the account to be given of this. Such an account would be bound to include references to challenges to accepted valuings, beliefs, presuppositions, etc. It would then be for investigation whether we could reach an understanding of the process of problem-generating which throw any light on likely methods of problem-solving or viable means for problem-facing.

However, the choice of a field or fields, or specific problems within them, is clearly for the group to make and should be made by the group, as part of its initial activities. Hence it is proposed that it should be agreed that a choice is to be made as soon as possible of the specific area or areas for a pilot investigation.

Finally, it is suggested that there is one general issue which any investigation concerned with the biological sciences and the quality of life will have to be considering throughout. In relation to genetics for example, it is probable that a basically disturbing factor is the apparent implication of the discoveries concerning the genetic code that the "make-up" of man (and therefore of individual man) is basically determined by a chemically triggered and operated information system. That is to say that the whole matter of reductionism has to be faced. This should be done by bringing it in as it proves necessary to do so and at points where it can clearly be shown to be relevant and required. Then it will be necessary to consider not only the logical status of the case for and against reductionism but also the psychological and sociological effects on habitual evaluation procedures of the strength of the apparent case for reductionism.

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The proposed approach, then, for starting on the topic "Biology and the Quality of Life" as a sub-heading of the topic "Science and the Quality of Life" is to investigate the practice of some particular sciences as a human activity and to consider how this practice generates problems about the quality of life.

A brief and sketchy attempt will now be made to indicate how it might be shown that the practice of the science of genetics generates such problems and some indication will be given of how these problems perhaps represent problems generated by science more generally. This may serve as a model for the consultation to develop in any of the fields it proposes to investigate.

(1) Firstly we have those developments in genetics which produce the possibilities now referred to under the general heading of Euphenics, i.e. those developments which permit or may permit the specifically desired modification of the phenotype of a defective organism by treatment. Such treatment is directed towards an already existing individual, as distinct from eugenics where the concern is with the prevention or promotion of the birth of individuals with certain (genetically-based) characteristics.

One such problem which arises out of this whole field is that often referred to as "the increase in the genetic load" viz. the effect on future generations of saving genetically-defective individuals from the effect of that defect as to their own living so that they remain alive to breed and pass on the defects. Careful documentation (which could, presumably, easily be put together by someone competent in the field) would seem to be required here. It would then be for consideration whether there is anything uniquely disturbing in this matter or whether it is simply one more case of the way in which man is modifying himself and his environment. In which case some attempt would have to be made at assessing the comparative urgency of this particular factor. It is likely, of course, that a major element in the overall disturbance to our understanding of, and concern for, the quality of life is precisely the rapidly increasing number of ways in which man can now be seen to be modifying himself and his environment. What may be called the phenotypic adjustment should, therefore, perhaps be seen chiefly as contributing to that critical number of interference factors which have cumulatively contributed to the disturbance we are attempting to face.

We may, therefore, have here a general question about <u>science and the production of interference factors</u>. How should we assess these interference factors? And are many of them really of first-class importance with regard to the quality of human life? e.g. Is there any point in worrying about genetic load unless and until we have tackled those world systems which increase poverty or pollute the environment?

(2) However, if we do pursue the narrow field of genetics one aspect of the genetic-load problem presumably falls to be considered under one aspect of eugenics viz. what should and could be done to prevent persons with recognized genetic defects from passing them on? This leads in to the sphere in which developments in genetical understanding appear to make it possible or desirable to prevent the birth of the genetically handicapped or promote the birth of the genetically privileged (see below for a brief discussion of the further investigation required by the phrases "genetically handicapped" and "genetically privileged").

First, we need a succint account of the facts and methods which are relevant to negative eugenics viz. any programme of preventing birth of the genetically handicapped either by aborting foetus or by, in some way, discouraging marriages which are likely to produce genetically handicapped offspring. It would seem necessary to have a reasonably comprehensive list of diseases which are at present known to be genetically transmitted, together with a summary of such statistics as are available for the incidence of the diseases and the probability of transmission. Similarly, with regard to conditions which can be detected in the embryo it is necessary to know which diseases can be detected by what methods with what probability. On the basis of such data it should be possible to go on to state the case for positive promotion of measures in negative eugenics, to argue the degree of urgency and to outline the nature of the urgency.

Here, again, attention should eventually be focussed on the question of newness. Is there a new dimension, for instance, added to the abortion debate? It seems possible that there might be, in that the case for abortion is to be related not only to the private freedom and wishes of the couple involved but also, very directly, to the corporate genetic load of mankind. However both the factual and evaluative sides of such an argument would need investigation. What, for instance, on the factual side is the status and bearing of information about the possible elimination of genes which are in some circumstances deleterious but in others advantageous? Presumably, such a question already touches on the more general question of what is meant by "genetically handicapped" and how far this is a purely descriptive term which would commend universal acceptance in a given case or class of cases.

Two generalizable questions seem to arise here viz:

(a) <u>What is really new about the issues to be faced</u>?

(b) <u>Does the newness include a new case for subordinating the possibilities of individuals, couples or families to the whole</u>?

(3) As soon as one moves to positive eugenics, i.e. the positive promotion of certain genetical patterns then the full force of the question about the meaning of "handicapped" and "privileged" in the genetical sphere becomes obvious. It is probably in the matter of positive eugenics that the most "disturbing" questions arise. However, it would seem necessary first to have a realistic assessment of what the actual possibilities are at the present time for genetic engineering, genetic surgery, selecting for qualities (including such a possibilitiy as breeding from sperm banks) and the reproduction of identical individuals by cloning. A factual account is required of what can be done, of the methods of experimentation by which discoveries so far have been made and of the methods of experimentation which are at present in use of projected in order to carry the discoveries further. It is probable that it is in the methods already being employed here and in the possible implications of what is likely to be able to be done that the biggest psychological and sociological disturbances will be found.

One thing, however, is clear. It might be possible to establish very broad agreement about a certain section of the meaning of the phrase "genetically handicapped". This would refer to acute physical and mental defect passed on in the genes and which were liable to promote rapid death or very clear malfunctioning (e.g. phenylketonuria, Down's syndrome, retinoblastoma). Once this area of acute malfunctioning was left behind, however, any further question of "genetic defect" and still more any positive definition whatever of what should be promoted as "genetic advantages" would be highly questionable and unlikely to receive any broad agreement of the kind that cannot be argued against very strongly. It is not at all clear why geneticists or any other scientists should, qua scientists, be in any privileged position to offer definitions or suggestions here. As human beings they would of course, have the right, and might very well have the duty, to offer suggestions. But the point at issue is on what grounds they would have any particular authority or privileged views.

This would seem to raise a general question relevant to science and the quality of life viz. <u>in what ways, if any, are scientists in any privileged position on this question</u>?

(4) A line of investigation which might well prove fruitful would be to examine the works of these geneticists (if any) who do claim to be able to make authoritative statements about positive eugenics and to analyze the grounds on which they claim to be justified in passing from scientific statements about what can or might be done to moral or political statements about what should be done. This might also throw light on the more general question as to whether one of the chief sources of the overall disturbance we are seeking to investigate is to be found in an implicit assumption in much actually current practice of science (although not, presumably a necessary assumption in the logic of science) that what can be done should be done because it can be done (and, perhaps, because knowledge will be increased if it is done).

This last point touches on the methods and assumptions of experimental investigation, an issue which, I suspect, our investigation will tend to show to be particularly acute in the field of genetics. It is alleged that developments in this field have acutely raised the question of "What are men for?" and it is suggested that we need to look for new values and understandings in the world at large in order to cope with the crisis thus precipitated. The urgency and the critical nature of the questions posed are not to be denied. But it is sufficient to look <u>outwards</u> for the material to face these critical and searching questions? Might it not be necessary also to look <u>inwards</u>, i.e. into the very assumptions manifested in the taken-for-granted practices of science and, in particular, of genetics?

For example what is the implied view of "What men are for" contained in the experimental procedures at present used to gain further genetic and embryological knowledge by cultivating human embryos in vitro? A recent article in <u>Scientific American</u> (for December 1970) entitled "Human Embryos in the Laboratory" concludes: "We are well aware that this work presents challenges to a number of established social and ethical concepts. In our

opinion the emphasis should be on the rewards that the work promises (my emphasis) in fundamental knowledge and medicine". It may very well be that such a conclusion is as stupidly dogmatic and ethically cowardly as any theological utterance which obfuscates the complicated issues involved in abortion by a statement such as "it is clear that the sacredness of life involves a total respect for the human embryo and that this respect precludes any case for abortion".

What, for example, are the grounds for making of "fundamental knowledge" an absolute and overriding idol? And how far is or can be "medicine" separated from "social and ethical concepts"? "Fundamental knowledge" may be as sacred a cow as "revelation". The possibility should at any rate be investigated. This investigation would, once again, involve a detailed inquiry into the methods involved in the experiments discussed in the article referred to and in the implicit approach to "humanum" which may or may not be involved here. I am not myself clear whether repugnance to "test-tube babies" is simply psychological shock or a symptom of something more fundamental about reverence for life. I repeat, I just don't know. But it seems to me both unscientific and inhuman just to assume that there is nothing deeply significant to be investigated. It might be that we can get no satisfactory answer to the question "What are men for?" unless scientists give up certain types of experimentation. It might be that this type of experimentation cannot and must not be given up but that other means have to be found of preserving and developing reverence for life.

These questions, arising out of what is actually involved in the scientific practice of genetic research (rather than creating diversions by making a noise about the results) would probably prove an important bridge between investigations in this field and the pressing questions of ecology and environment. For I suspect that the problem here is a taken-for-granted attitude of exploitation to the Universe which is destructive of all reverence for life and that this is also to be seen in much scientific experimentation conducted in the name of the pursuit of knowledge. Everything from human reproductive tissue through rats and rabbits to apes can be exploited in order to gain knowledge, whatever violence is done to them thereby. Consider, for example, experimentation with shock techniques on apes in order to test such matters as aggressive reactions or learning procedures. In order to advance knowledge it is taken for granted that monkeys can be driven mad by what amounts to systematic torture. Of course, it is "unthinkable" that such methods should be given up, for how else can science advance? But will this notion stand up to investigation if there is a real concern about "What are men for?".

The generalizable question here is how far is the practice of science in itself a human activity which contributes to a diminution of the quality of life not chiefly because of the basic techniques, nor chiefly because of the results achieved but because of the manner in which the techniques are practised within the scientific disciplines themselves. In particular there is the question of exploitation.

The last stages of the argument above should indicate the way in which an investigation of problem-generating developments would necessarily raise

questions for all the disciplines involved. We might disoover the universal relevance of the biblical saying "Except ye repent, ye shall all likewise perish". Of course, we might not. But I would submit that unless we set up a process of investigation which will promote a questioning as radical as this we shall not begin to measure up to the magnitude of the disturbance of which the disturbance caused by developments in genetics is but one sector of the disturbance caused by biology and by the sciences at large.

I would suggest that it is as we help one another, with a full use of our respective expertises, to probe into the causes and features of the disturbance that we shall have a chance of discovering whether faith and theology, the reflection on and systematization of faith, do or can speak to men in this disturbance. It will be, I am suggesting, of no use simply to try and have concern about what genetics or any other science has thrown up. For the genetics which has thrown these things up is a <u>human</u> activity and it is this activity which must be the starting-point of study. Hence my initial proposal to set about constructing a good descriptive account of the disturbance-generating developments. If this descriptive list were compiled with an eye to the considerations outlined above I believe it would provide the best starting-point for a collaborative investigation into the quality of life in which scientists, social scientists and theologians were given the opportunity of discovering how their disciplines were really questioned and what their disciplines could truly and relevantly contribute to man as he faces the latest version of the agonized questions "Who am I?" and "What am I for?"

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SNAKE NESTS AND ICONS

- some observations on theology and ecology

by
Lynn White, Jr.

(Professor White teaches medieval history at the University of California, Los Angeles. In 1966, in a widely publicised address to the American Association for the Advancement of Science, he blamed "orthodox Christian arrogance towards nature" for much of the ecological trouble in which the affluent West now finds itself.

The speech, later published in Science (10th March, 1967) under the title "The Historical Roots of Our Ecologic Crisis", sparked widespread controversy about the role of religious presuppositions in shaping man's use - and misuse - of technology.

Professor White recently visited Geneva, where a tape recorder overheard the following conversation with David Gill of the Church and Society staff.)

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avid Gill Tell us something of how your thinking about the theological aspect of the ecology problem has moved since 1966.

ynn White The reason why it has moved or not moved goes back considerably earlier. My first conviction that what happens ecologically is related to religious presuppositions emerged from an episode in Ceylon. I saw, while visiting that country in 1926, a group of road builders carefully leaving cones of earth in cuts where snakes' nests were found. Naively as a westerner, I assumed that this was because the workers were afraid of snakes. A British official with whom I spoke said: "Oh, nonsense. We all live with snakes; these people live with snakes from birth. No, it's not fear. Theirs is a society that believes in reincarnation and this is the snake's home. That snake may well have been a relative of yours at one time, so you don't oust the snake from its home - you dig around it. After the snake gets a bit bored by the noise and the digging he moves out, and when you've ascertained that the snake is no longer in its

house, then it's all right to remove the cone." In the long run you build the road, but religious presuppositions slow down the process.

Well, I thought little of this until I began to get into the history of technology in the Middle Ages. More and more it seemed to me that I could find out what happened, but I couldn't find out very easily why it happened. I don't know whether you've seen my little book on Medieval Technology and Social Change. It is a "what" book which gathers together a great deal of factual material. But after assembling the data it was clear to me that I had not explained the phenomenon I was studying. Medieval Europe developed technology at an accelerated pace in many of its aspects more successfully than any other culture save possibly the Chinese. Indeed, by the middle of the 14th century the pace of innovation in Europe exceeded that in China, and strangely in China it was beginning to slow by the later 14th century. Joseph Needham, whose great Science and Civilisation in China is gradually being published, is terribly troubled and puzzled by the problem of why the scientific and technological thrust of traditional China went to pieces under the Ming dynasty and continued to be in a somnolent condition from there on.

Since putting out that book in 1962 I have tried to go into the "why" question rather than the "what", and this is infinitely stickier. Infinitely stickier. But the deeper I get into trying to explain such things, the more I am convinced that one must examine basic presuppositions about human destiny, the relation of the individual to the physical environment, and the whole concept of Man's Dominion.

I would like some day to do a little article on Man's Dominion as it is reflected in Christian iconography, because here a sharp distinction emerges between the Greek Church and the Latin Church. In the Greek manuscripts pertaining to Man's Dominion the pictures show Adam sitting in the garden of Eden quite passively with the animals scattered around him. Sometimes in these Greek paintings the hand of God appears from a cloud to bless the whole situation. The western pictures are very different in mood. God is standing with Adam and he has seized Adam's arm in his left hand. With a very hortatory gesture God is telling Adam exactly what should be done, now. There's an urgency about this which is totally lacking in the Greek pictures, and the poor animals are far from being relaxed. They are all huddled off in a corner looking scared - and in view of the long-term impact of the attitude reflected in these pictures, I think they have a right to look scared!

It was only after I did that 1966 speech to the AAAS which appeared on 10th March, 1967 in Science, that I found the work of Ernst Benz of Marburg. This man has done superb work on the Spiritual Franciscans and the Joachites of the 13th century. Apparently Benz went to lecture in Japan, where he was greatly interested and a bit horrified by what seemed to him to be the emphatically anti-technological emphasis of Zen Buddhism. His thinking did not go on to the real enigma of why a society whose upper-crust had been so profoundly influenced by Zen was able, in the Meiji Restoration, to transform Japan in such a very few years and to industrialise it so successfully. Benz's most profound analysis of the relation of Christian dogma to the technological thrust of the European Middle Ages is in the symposium Tecnica e casistica - technology and moral theology (edited by Enrico Castelli, who is an Italian philosopher who has a habit of editing admirable symposia and then publishing them so obscurely that it is almost impossible to get a copy). What bothered me about Benz's insight into the relation of Christian dogma to western technology was that everything that he said to explain the theological foundations of the western thrust should also, on his thesis, have applied to the Greek east, because all of the basic dogmas that he cites were shared equally by Greek and Latin Christians. Yet after the invention of Greek fire in the late 7th century there was not a major technological innovation among the Greeks. In fact, they didn't care about this sort of thing. It is symbolic that the Byzantines never manufactured paper, even though they could have made it just as easily as not. The result of all this is that I have been working on an article called "Cultural Climates and Medieval Technological Advance" that is appearing in Viator 2 (1971). It is more or less a comparative anthropology of the Byzantine East and the Latin West in the Middle Ages with reference to technological interests.

Take two striking examples of different religious attitudes towards mechanisms: the pipe organ and the clock. Before the mechanical clock, the pipe organ was the most complex machine known. It's really very intricate. Of course it comes from classical Antiquity and was continued in Byzantium as a secular instrument. It never has been used in the eastern churches where only the unaccompanied human voice is thought suitable for the praise of God. Pipe organs disappeared in western Europe, presumably because they were so difficult to keep in repair during the desperately chaotic period of the Germanic invasions. They were reintroduced for secular festivals in the very late 8th century: there was a Greek imperial gift of one to Charlemagne. We don't know what happened to that, but in the early 9th century they began making them in the West. An abbot

who presumably had learnt the art in Constantinople built one for his own abbey and then they spread like wild fire in the churches of Germany. By the 10th century, monster organs were being constructed, and not only in Germany. The most famous was at Winchester: 400 pipes and 25 bellows operated by 70 men! This was a big machine! By the 13th century organ music has penetrated even the Canon of the Latin Mass.

When the mechanical clock was invented in the West - not invented by clergy, I believe, but primarily by medical astrologers for their own professional purposes - at once the Church seized on these as visual educators showing the orderliness of God's creation. It began putting them not only on church towers but inside the churches to instruct people in the ways of the Creator. They were far more than merely time-keeping devices. They were homiletic devices. But never in the East. In the 17th century an Englishman, on the Czar's order, built a clock over the Saviour's Gate of the Kremlin. Th Kremlin in Russian thinking had become identified with the Heavenly Jerusalem. There was a terrible reaction: the faithful rose up and said that this was the contamination of eternity by time. Well, it stayed there because the Czar had ordered it, but there were profound, highly emotional objections, and even today you do not get clocks on or in eastern churches; they are never more than adjacent.

What would seem to emerge is that from very early times the West was spiritually congenial with mechanism whereas the eastern segment of Christianity felt suspicious of mechanisation. When you have two symbols each involving the most complex mechanism of the time, I think this begins to mean something.

David Gill — You give a lot of weight to the theological presuppositions underlying a culture. How do you make the judgement that these presuppositions deserve so much weight, in view of the difference you have outlined between East and West?

Lynn White — I can't find any better explanation. Technology involves action. Comparing Byzantium with the West, I have found I have to come back to an old platitude. That is, that the temper of eastern Christianity, from the beginning, has been contemplative and intellectual whereas the temper of western Christianity, not just from Saint Augustine but from Tertullian, has been voluntarist and activist. Now one can talk about some of the reasons for this, but without any expectation of being conclusive Whenever you ask a "why" question, and think you have an answer, you are always driven back: well, "why" what? I think "why"

questions are inherently questions that keep on peeling the onion. "What" questions much less so. "What" questions can be factual; the "why" questions are by their nature interpretative.

id Gill Leaving the Latin-Byzantium contrast for the moment, surely the experience of Japan would seem to underline the importance of non-theological factors for change in technology?

n White No, I don't think that that follows at all. I don't think we know. There is a capacity in the Japanese for the accommodation of paradox which is very puzzling to western minds. Ruth Benedict's amazing The Crysanthemum and the Sword emphasises that whereas contradiction involves a sense of sin and of guilt in the West, personality strains in Japan stem far less from guilt or a sense of contradiction than from shame in social relationships. This is a profound difference, if she is right. All I'm saying is that I don't think we know enough to be very sure about these things as yet.

There's another historical problem which is terribly puzzling and I think not unrelated. After all, the business about pollution and ecology is very clearly linked not only to technology but to science. This wedding of science to technology is remarkably recent. Francis Bacon said in the early 17th century that knowledge was power, but he didn't do anything about it himself. In fact, technology remained overwhelmingly an empirical activity down to the 1850's or 1860's. The change begins in the chemical industries in the 18th century but it doesn't go very rapidly. Then there was a marriage of the two, and within a hundred years we are faced with a totally new situation; one that has really no historical parallel and consequently on which purely historical judgements can provide no guidance. All that our study of history can do is to sophisticate the eyes with which we look at the present.

One of the things that we have not done is to look at past scientific movements which have decayed and ask with much more rigour than hitherto "why did they decay?". We have considerable knowledge of three of these: the Greek, the medieval Muslim and the Chinese. As I indicated, Joe Needham is wracking his brains trying to figure out what went wrong in China - scientifically, not merely technologically. I'm trying to persuade one of my colleagues to do an essay on the "why" of the decay of the really extraordinary and prolonged Islamic scientific movement - practically all of which was of course absorbed into the western movement through Latin translations

from the Arabic. Why did ancient Greek science go to pieces? We still don't know. I have been trying to get my scientific friends - and I know some very good scientists - to contemplate their own situation. Why have so many young people reacted so badly against science? Why at McGill University (Montreal) and again at Fresno State College did the alienated kids march in and smash million-dollar computers? This is idiocy. But to cope with such irrationality, we must try to understand what the computer means symbolically to them. It isn't sufficient just to condemn. University enrollments in science, both in Europe and in America, are tending to go down. What's wrong?

David Gill — So you find real significance in the so-called "counter-culture", with its calls for a break with the technocratic mind-set? Presumably for its exponents the smashing of computers is a highly prophetic act.

Lynn White — Well, yes of course: otherwise they wouldn't do it. As for me, I think we've got to have computers. The job is to use them with sensibility. May I say that one of the things that made me happiest while skimming over the reports of your Working Committee (Nemi, June 1971) is that I could find no reflection of the Jacques Ellul position. I had rather thought, with him being a French Protestant, that there would be some sympathy with that.

David Gill — Ellul I think is winning more attention in the United States than in some other places.

Lynn White — He has won more attention than his position deserves, I believe. This is a curious revived demonism: maybe God is dead, but Satan is alive and Satan's name is Technology! Well I am relieved.

David Gill — The ecology debate has many ramifications. What aspects of it do you regard as having a special claim on the attention of the churches?

Lynn White — Looking over your study plans I tended to think that you are going to bog down unless you get smaller defined areas with a more explicitly religious and theological focus. That means less emphasis on looking for concrete action plans. I know this is regarded by some as evasive and diversionary, but everybody is looking for concrete action plans without asking in terms of what these plans should be formulated and in terms of what types of action these plans may rightly be implemented.

I recall a letter - a deeply-troubled, very amusing letter from a graduate student in philosophy which reached me about a year ago. This young man had read that Science thing of mine. He said that he had decided to write his dissertation on the whole question of whether it is possible to be ethical to things other than human beings. He said "My wife has been telling me for years that we have moral responsibilities towards nature. For a long time I thought she was speaking in prudential terms - you know, unless we keep the forests in good shape we are going to get erosion and then there will be disastrous results of many kinds. But eventually I found that she was not talking about the backlash of an abused nature but was speaking in simple, fundamental, non-prudential terms." And he added: "I myself am so deeply embedded in what you call the Judeo-Christian tradition that I have found it very difficult to formulate the question of what our responsibility is, if any, towards a gopher or a rock. Do we have such a responsibility?".

To ask such a question is to raise a moral issue of the greatest importance. I know a woman in California who finally got the bounty taken off mountain lions. Her argument had to be prudential: that is, that mountain lions really did not kill very many cattle and that they were the one successful way of keeping down overpopulation of deer, which were devouring the range and damaging the cattle industry much more than mountain lions. But her real motivation was not prudential. She's also done a great deal to save the sea otter. I told her I would join a "Love the Rattle Snake Society" if she founded one because ...

id Gill ... if she can come up with a prudential argument on that one she'll be doing pretty well!

n White Yes. But the question is are we compelled as Christians to use merely prudential arguments in this area of thinking? The Saint Francis of the Fioretti did not think so, apparently. (Whether the real Saint Francis thought so is another matter.) The Jains or the Hindus, with their doctrine of reincarnation, don't think so. They feel that there are moral obligations to these creatures as spiritual entities.

id Gill Yes. But their society consequently gets into a considerable mess, doesn't it?

n White It can get into a dreadful mess! My wife and I were horrified at the spectacle of Calcutta and we yearned to take the sacred cows that were blocking the traffic and turn them into hamburgers to feed to the city's refugees! People are part of nature too;

the other creatures don't have all the rights.

I suggest that you in the World Council of Churches may be able to help with this problem of whether or not a Christian has a moral obligation - a non-prudential moral obligation - to anything save the person. This is an area in which there are not many recessive genes in the Christian tradition to help us. There are some, of course, especially in the Old Testament. I wish your biblical scholars could help me with that canticle Benedicite, which is still habitually sung in Anglican services but otherwise has been cut out of Protestantism because it does not exist in the Massoretic Text of Daniel. I would like to know what the best opinion is as to where and when and by what sort of person this was written, because this is a superb statement of the spiritual democracy of all of God's creatures, including the "inanimate". It's an absolutely remarkable thing. It has been used in both the Greek and the Latin churches as a canticle from very early times but its implications have never really been taken seriously by theologians because their thinking has been dominated by the first chapter of Genesis and the Dominion concept. The Dominion concept is lacking in it. I can't escape a feeling that it was written by a Hellenised Jew of Alexandria who, brooding deeply over the rigid monotheism of his own tradition, felt that there were dangers in it and was trying to maintain monotheism and at the same time salvage some of the values of pagan animism.

Perhaps the most shocking way in which we can phrase the quest for a theology of ecology at the present time is as follows: what is a viable, modern, Christian equivalent of animism? The question shouldn't be asked publicly in that way, because to ask it thus would be to alienate a good many people unnecessarily. I am not wanting a revival of animism! I am searching for ways to regain perception of the spirituality of all creatures and to demote modern man from absolute monarchy over nature.

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Readingroom
NOT FOR LOAN

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